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NATIONAL DAM SAFETY PROGRAM. SUNRISE LAKE DAM (MO 30043). LOWER--ETC(U)
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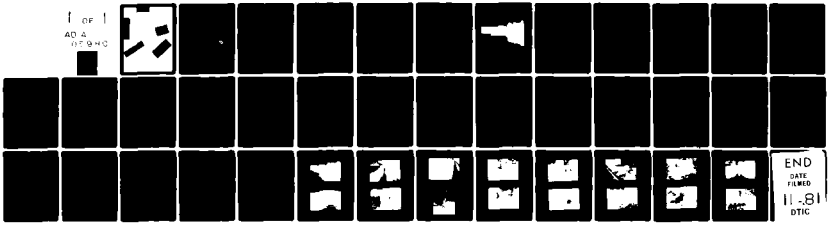

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.	

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SUNRISE LAKE DAM
WAYNE COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30043

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI

AUGUST 1978

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

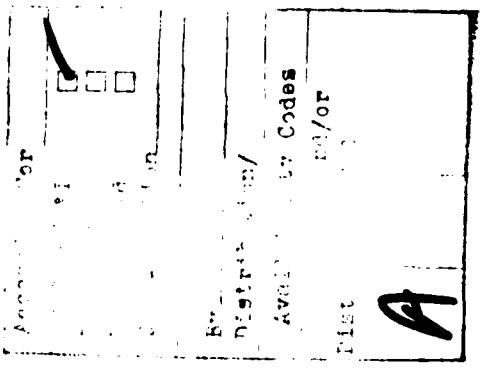
Name of Dam	Sunrise Lake Dam
State Located	Missouri
County Located	Wayne County
Stream	Unnamed tributary to Rings Creek
Date of Inspection	12 July 1978

Sunrise Lake Dam was inspected by an interdisciplinary team of engineers from the Memphis District, U. S. Army Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten the life and property of approximately 3 families downstream of the dam.

The inspection and evaluation indicate that the spillway does not meet the criteria set forth in the guidelines for a dam having the above mentioned size classification and hazard potential. According to the guidelines, the spillway is required to pass the Probable Maximum Flood (PMF) without the dam embankment being overtopped. The spillway will only pass 15 percent of the PMF before the dam embankment is overtopped. Because the spillway will not pass one half of the PMF without overtopping, the dam is classified as "unsafe non-emergency". The spillway will not pass the 100-year flood without overtopping, which is a flood that has a 1 percent chance of being exceeded in any given year.

Other deficiencies visually observed by the inspection team were trees and bushes on the embankment and adjacent to the spillway, erosion gullies and animal burrows on the embankment, and seepage. Another deficiency found was the lack of seepage and stability analysis records.



It is recommended that the owner take action to correct or control the deficiencies described. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design and construction of dams.

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APPROVED BY: SIGNED — Colonel, CE, District Engineer — 22 SEP 19[illegible] — Date

Overview of Lake and Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
SUNRISE LAKE DAM - ID NO. 30043

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

LIST OF PLATES

TABLE OF CONTENTS (Cont'd)

LIST OF PLATES

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer for the St. Louis District, Corps of Engineers, directed that a safety inspection of the Sunrise Lake Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many State agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earth structure built in a narrow valley in the uplands which border the Mississippi Embayment Topography adjacent to the valley is rolling to steep. Soils in the area are formed of red silty clays with fragments of dolomite and chert. Topography in the vicinity of the dam is shown on Plate 2.

(2) The spillway is located in the right abutment and consists of a concrete weir and apron. A lake drain consisting of a pipe is connected to a 9-inch control valve downstream of the dam embankment.

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the northwestern portion of Wayne County, Missouri, as shown on Plate 1. The lake formed

by the dam is shown on the Patterson, Missouri Quadrangle sheet in Section 24; Township 29 North; Range 4 East.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1 c above. Based on these criteria, this dam and impoundment is in the small size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in a High Hazard Classification.

e. Ownership. This dam is owned by the Mountain Lake Hunting and Fishing League of Piedmont, Missouri 63957.

f. Purpose of Dam. The dam forms a 9-acre recreational lake.

g. Design and Construction History. The dam reportedly was initially constructed in 1925 by a land development company, but soon after completion the dam failed. Then in 1928, the existing dam was constructed on top of the residual embankment.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, and evaporation all combine to maintain a relative stable water surface elevation. A lake drain is utilized for drawing down the lake level during the winter months for biological maintenance of the lake.

1.3 PERTINENT DATA

a. Drainage Area - 320 acres (1973 inventory).
322 acres (Topographic Quadrangle).

b. Discharge at Damsite.

(1) All discharge at the damsite is through an uncontrolled concrete spillway.

(2) Estimated experienced maximum flood at the damsite - unknown.

(3) Estimated ungated spillway capacities at maximum pool elevation - 300 cfs.

c. Elevation (Feet above M.S.L.)

(1) Top of dam - 557.0 ± (see Plate 3).

(2) Spillway crest - 551.2.

(3) Streambed at centerline of dam - 533 ± (Extrapolation from survey).

(4) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 1100 ± feet (USGS Quad Map.)

e. Storage (Acre-feet).

(1) Maximum - 72 (1973 inventory).
85 (USGS Quad Map, Survey and 60 acre-feet as normal storage).

(2) Normal - 60 (1973 inventory).

f. Reservoir Surface (Acres).

(1) Top of dam - 12.9 ±

(2) Spillway crest - 9.5 ±.

g. Dam.

(1) Type - earth embankment.

(2) Length - 450 ± feet.

(3) Height - 24 feet maximum.

(4) Top width - varies from 5-9 ± feet.

(5) Side slopes -

(a) Downstream - 1V on 1.8H (Average).

(b) Upstream - 1V on 2.4H (Average).

(6) Zoning - unknown.

(7) Impervious core - unknown.

(8) Cutoff - unknown.

(9) Grout curtain - unknown.

h. Diversion and Regulating Tunnel. None.

i. Spillway.

(1) Type - an uncontrolled concrete weir.

(2) Width of weir - 20.3 feet.

(3) Crest elevation - 554.8 feet m.s.l.

j. Regulating Outlet.

(1) Type - valve controlled.

(2) Length of pipe - 50 ± feet

(3) Invert of pipe in lake - 549.5 ± feet m.s.l.

(4) Discharge Invert - 547.2 feet m.s.l.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data are known to exist.

2.2 CONSTRUCTION

The dam reportedly was initially constructed in 1923 by a land development company, but soon after completion, the dam failed. Then in 1928, the existing dam was constructed on top of the residual embankment.

2.3 OPERATION

A lake drain is utilized for drawing down the lake level during the winter months for biological maintenance of the lake.

2.4 EVALUATION

a. Availability. The only engineering data readily available are the personal recollections of the League members.

b. Adequacy. The field and visual inspections presented herein are considered adequate to support the conclusions of this report. **Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analysis should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.**

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. Visual inspection of Sunrise Lake Dam was performed on 12 July 1979. Personnel making the inspection were employees of the Memphis District, Corps of Engineers, and included a geologist, hydraulic engineer, and soils engineer. Also a League member accompanied the inspection team. Specific observations are discussed below.

b. Project Geology. As the dam was constructed from local materials it probably consists of red silty clay with dolomite and chert fragments intermixed. The red clay is the result of weathering of the underlying dolomite. The soil represents the Recent which lies unconformably on the Eminence formation of the Cambrian. The Eminence consists of a tan to light brown, fine to medium grained, massively bedded, moderately hard calcarous dolomite. The dam is located in a Seismic Zone 2.

c. Dam. The crown of the dam has several erosion gullies on both the upstream and downstream sides of the crown, and these gullies continue several feet downslope (see Photo 3). The crown width varies from 5 to 9 feet. One animal burrow is located in the crown approximately 100 feet from the right abutment (see Photo 4). The entire dam embankment except for a narrow path on the crown is overgrown with trees and bushes (see Photos 2, 5 and 6). The alignment of the dam, as shown in the sketch presented on Plate 6 is "V" shaped toward the downstream. The "V" shaped alignment is probably caused by construction of the dam on the residual embankment of the failed dam discussed in paragraph 2.2.

Based on the cross-sections presented on Plates 4 and 5, the upstream embankment has an average slope of 1V on 2.1H. The downstream embankment slope is very steep (1V on 1.5H average slope) as shown on Plates 4 and 5 (see Photos 5 and 6). A 20-foot wide, area of saturation is located on the downstream embankment slope at baseline station 4+22 (see Photos 7 and 8). The area begins at elevation 546 feet m.s.l. on the slope and continues downslope to the toe (elevation 537.6 feet m.s.l.). The area is soft and percolates a small quantity of water.

An area of light seepage flow is located adjacent to the downstream toe between baseline stations 1+55 and 2+05. The area is soft and seeps less than 5 gpm. On the downstream slope of the

left abutment at station 4+72, a heavy flow of seepage begins at elevation 546.3 feet m.s.l. The quantity of seepage increases going downslope, until at the toe (see Photo 9) the seepage flow is approximately 160 gpm. Downstream of the toe, the ground surface is soft. Upslope from the toe, the area is covered with rock fragments and therefore the ground surface on the slope is firmer. The left abutment seepage reportedly began about 1955 and since then, there has been very little variation in the flow.

d. Appurtenant Structures. The spillway is located in the right abutment and consists of a concrete weir and apron (see Photos 10 thru 14). Two concrete walls approximately 6.5 feet high and 12.8 feet long parallel the apron. The concrete in the spillway is generally in good condition. A "V" shaped notch, 13 inches deep is cut into the concrete weir (see Photo 15). A stop log has been placed on the lakeside of the notch to deter the flow of water through the notch. Trees and bushes are growing adjacent to the spillway.

A lake drain consisting of a pipe is connected to a 9-inch control valve downstream of the dam embankment (see Photo 16). The valve is new and appears in good condition. Because of the unaccessible location of the drain, it could not be inspected. Reportedly the lake level is lowered every winter by the lake drain.

e. Reservoir Area. No wave wash, excessive erosion, or slides were observed along the shore of the reservoir.

f. Downstream Channel. The downstream channel is overgrown with trees and bushes just downstream of the spillway (see Photo 12).

3.2 EVALUATION

None of the conditions observed are significant enough to indicate a need for immediate remedial action or a serious potential of failure. Visually observed seepage, vegetation on the embankment and adjacent to the spillway, and erosion gullies and animal burrows on the embankment crown are deficiencies which, left uncontrolled or uncorrected, could lead to the development of potential problems.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillway is uncontrolled; therefore, no regulating procedures exists for this structure. The valve controlled lake drain is utilized every winter to draw down the lake level for biological lake maintenance.

4.2 MAINTENANCE OF DAM

Little maintenance has been done as shown by the vegetative growth on the embankment and adjacent to the spillway, and the erosion gullies and animal burrows on the embankment crown.

4.3 MAINTENANCE OF OPERATING FACILITIES

A new control valve has recently been installed. No other information is available concerning maintenance of the lake drain.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is unaware of any existing warning system for this dam.

4.5 EVALUATION

If the uncontrolled vegetation on the embankment and adjacent to the spillway, and the erosion on the embankment crown are allowed to continue, potential problems could develope.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No design data are available.

b. Experience Data. The drainage area and lake surface area are developed from USGS Patterson, Missouri Quadrangle. The spillway and dam layout are from surveys made during the inspection.

c. Visual Observations.

(1) The spillway and the exit channel are in good condition.

(2) Small trees and bushes are growing adjacent to the spillway and in the downstream channel.

(3) The spillway is located on the right abutment.

(4) The valve controlled lake drain could not be inspected because of the unaccessible location.

d. Overtopping Potential. The spillway will pass 15 percent of the Probable Maximum Flood (PMF), without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood discharge that may be expected from the most severe combination of critical meterologic and hydrologic conditions that are reasonably possible in the region. For its size and hazard category, this dam is required by the guidelines to pass from one-half PMF to PMF. However, considering the high hazard potential to life and property of approximately 3 families downstream of the dam, the spillway size and/or height of dam should be increased to pass the PMF, without overtopping the dam. Because the spillway will not pass one-half of the PMF without overtopping, the dam is classified as "unsafe non-emergency". The spillway will not pass the 100-year flood without overtopping, which is a flood that has a one percent chance of being exceeded in any given year.

The effect from rupture of the dam could extend approximately 2 miles downstream of the dam. There are approximately 3 inhabited homes downstream of the dam which could be severely damaged and lives of inhabitants could be lost should failure of the dam occur.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of the dam and appurtenant structures are discussed and evaluated in SECTIONS 3 and 5. The very steep downstream slope (1V on 1.8H) and the observed seepage areas on or near this slope raise concern for the continued stability of this dam. These conditions indicate that the stability safety factor of the downstream slope may be extremely low when compared to the suggested safety factors presented in the "Recommended Guidelines for Safety Inspection of Dams", and that a potential for internal piping of embankment and foundation material exists.

b. Design and Construction Data. The design and construction data were limited to that information discussed in SECTION 2.

c. Operation Records. There have been no known operations which have affected the structural stability of the dam.

d. Post Construction Changes. No post construction changes, other than those referenced in paragraph a above, exist which will affect the structural stability of the dam.

e. Seismic Stability. This dam is located in Seismic Zone 2. However, it is located very near the boundary between seismic Zones 2 and 3. Since this dam is located in Seismic Zone 2 and the proximity of Seismic Zone 5, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several items were noted during the visual inspection which should be corrected or controlled. These items are trees and bushes on the embankment and adjacent to the spillway, erosion gullies and animal burrows on the embankment crown, a very steep downstream slope, and observed seepage. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. Also these analyses should be utilized to detail the corrective actions called for in paragraph 7.2. The Probable Maximum Flood (the design flood) and one half of the Probable Maximum Flood will both overtop the dam.

b. Adequacy of Information. Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The stability and seepage analyses should be given priority by the owner and accomplished without delay in order to determine if corrective measures are necessary. If the safety deficiencies listed in paragraph 7.1a are not corrected in a timely manner, they could lead to the development of potential problems.

d. Necessity for Phase II. Based on the results of the Phase I inspection, no Phase II inspection is recommended.

e. Seismic Stability. This dam is located in Seismic Zone 2. However, it is located very near the boundary between Seismic Zones 2 and 3. Since this dam is located in Seismic Zone 2 and the proximity of Seismic Zone 3, it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dam.

7.2 REMEDIAL MEASURES

a. Alternatives. Spillway size and/or height of dam should be increased to pass the Probable Maximum Flood without overtopping the dam.

b. Perform seepage and stability analyses to assess the safety concerns raised by the observed seepage, the saturated area on the downstream slope, and the steep downstream slope. Use the results of these analyses to design appropriate corrective measures.

c. O & M Maintenance and Procedures. The following O & M maintenance and procedures are recommended:

(1) Remove trees and bushes on the embankment, adjacent to the spillway, and in the downstream channel. Care should be taken during removal not to destroy the existing conditions of the embankment, the spillway, and the downstream channel.

(2) Establish and maintain a grass cover on the embankment.

(3) Repair the embankment crown where gullies and animal burrows have formed.

(4) The downstream slope and toe should be closely monitored for seepage and erosion. If seepage quantities and/or erosion observed during monitoring indicate increases or signs of material being piped from the embankment, immediate action shall be taken to rectify these conditions.

(5) A detailed inspection of the dam should be made at least every 5 years by an engineer experienced in design and construction of dams.

APPENDIX A

HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. HEC-1 was used to develop the inflow hydrograph for PMF and hydrologic characteristic of drainage basin.

2. HEC-1 uses Snyder Method for developing synthetic unit hydrographs with Clarks Modification.

Final Variables

Drainage Area	0.50 sq. mi.
Travel Time of Runoff	30 min.
Initial Loss of Ranifall	0.5 in.
Average Loss Rate	0.05 in./hr.
C_t	0.60
C_p	0.698
PMF Rainfall	26.9 in.
PMF Percentages	6 hr. 102
	12 hr. 120
	24 hr. 130

3. The inflow hydrograph was routed through the reservoir using HEC-1's modified Puls option. The broad-crested weir equation was used to calculate spillway discharges.

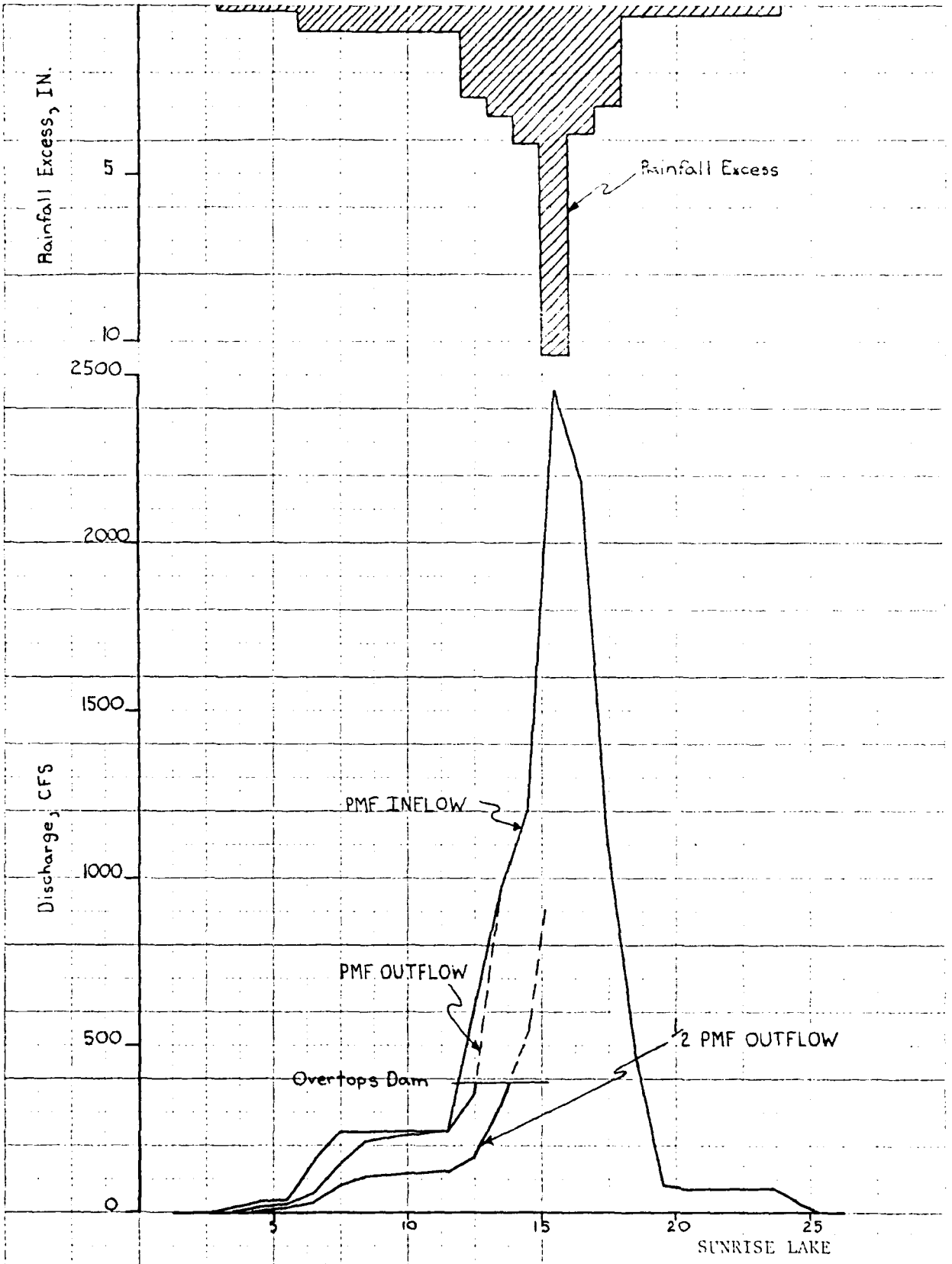
Spillway

C = 3.0
L = 29.3

Top of Dam

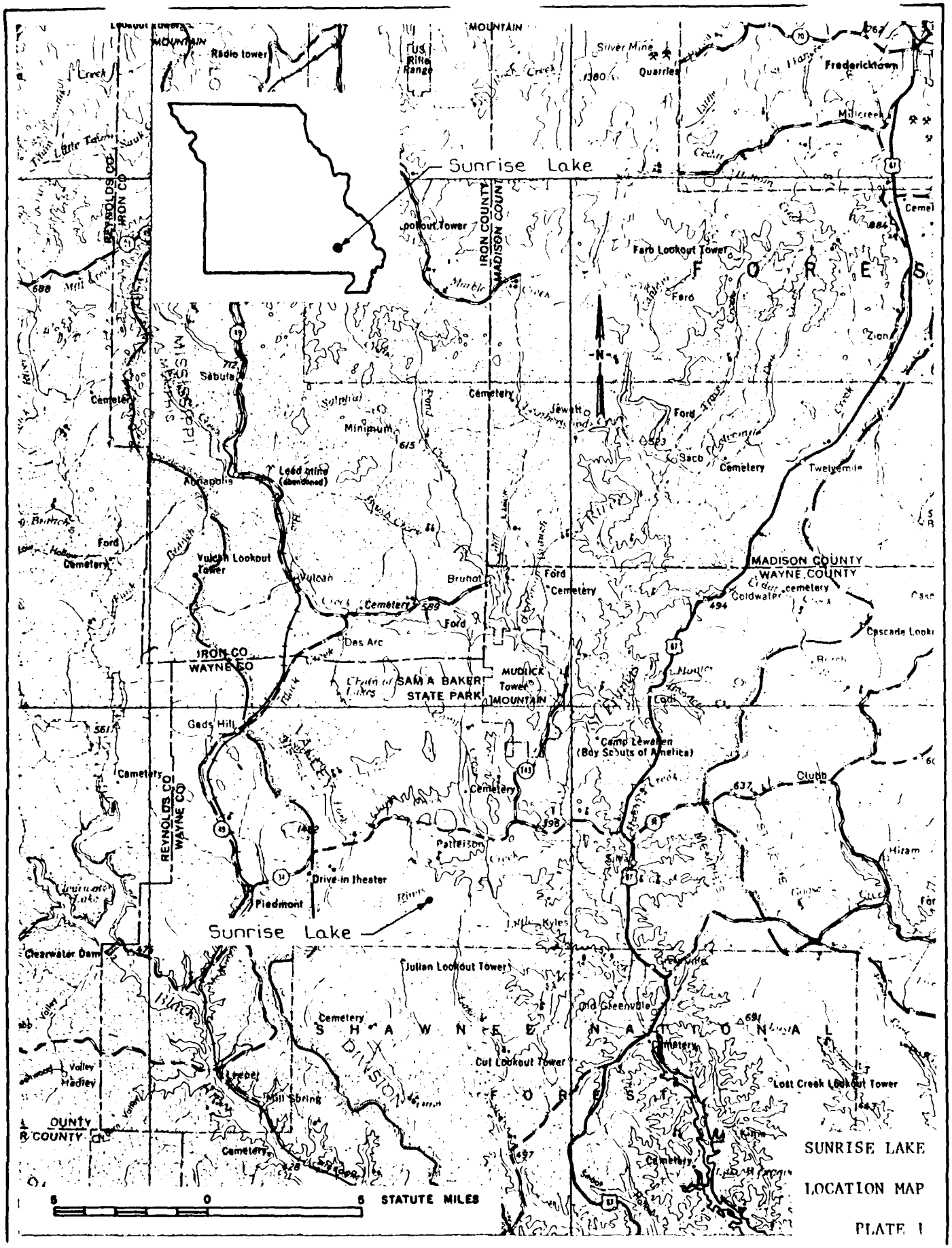
C = 2.8
L = 200 feet (el. 557.0 feet m.s.l.)
250 feet (el. 557.5 feet m.s.l.)

4. PMF rainfall distribution, inflow hydrograph, and outflow hydrograph are shown on Plate A1.



INFLOW and OUTFLOW HYDROGRAPHS

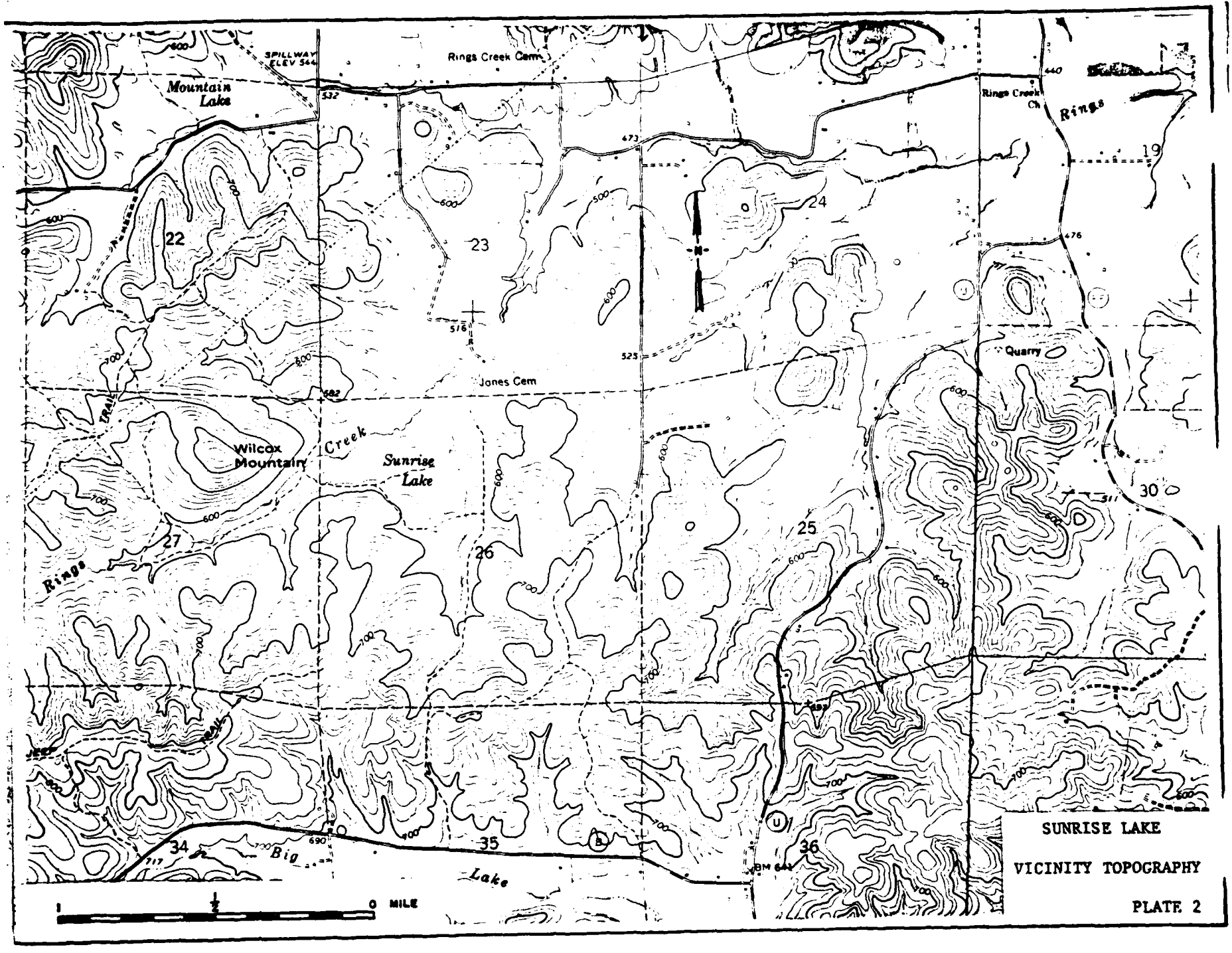
PLATE A1



SUNRISE LAKE

LOCATION MAP

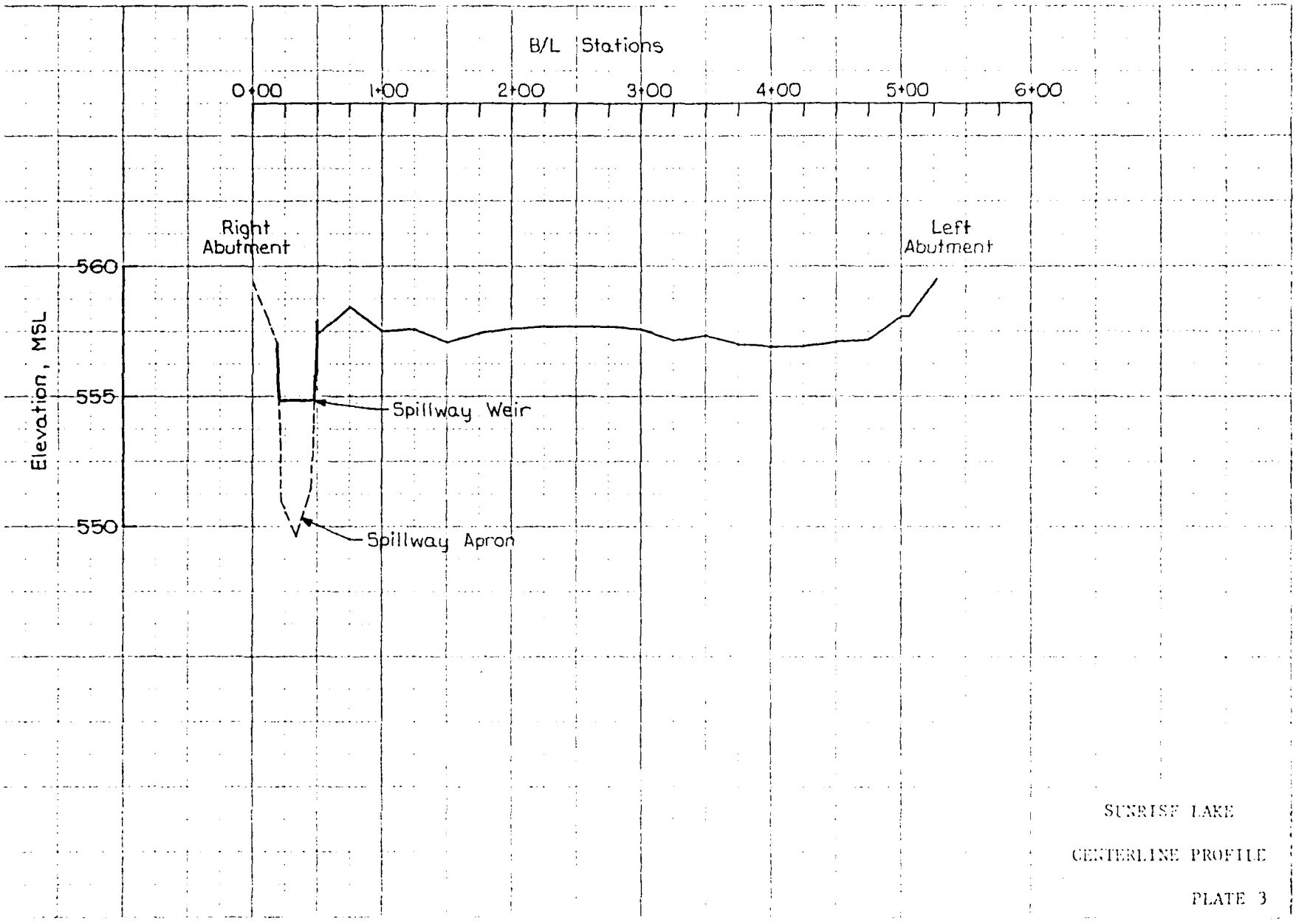
PLATE 1



SUNRISE LAKE

VICINITY TOPOGRAPHY

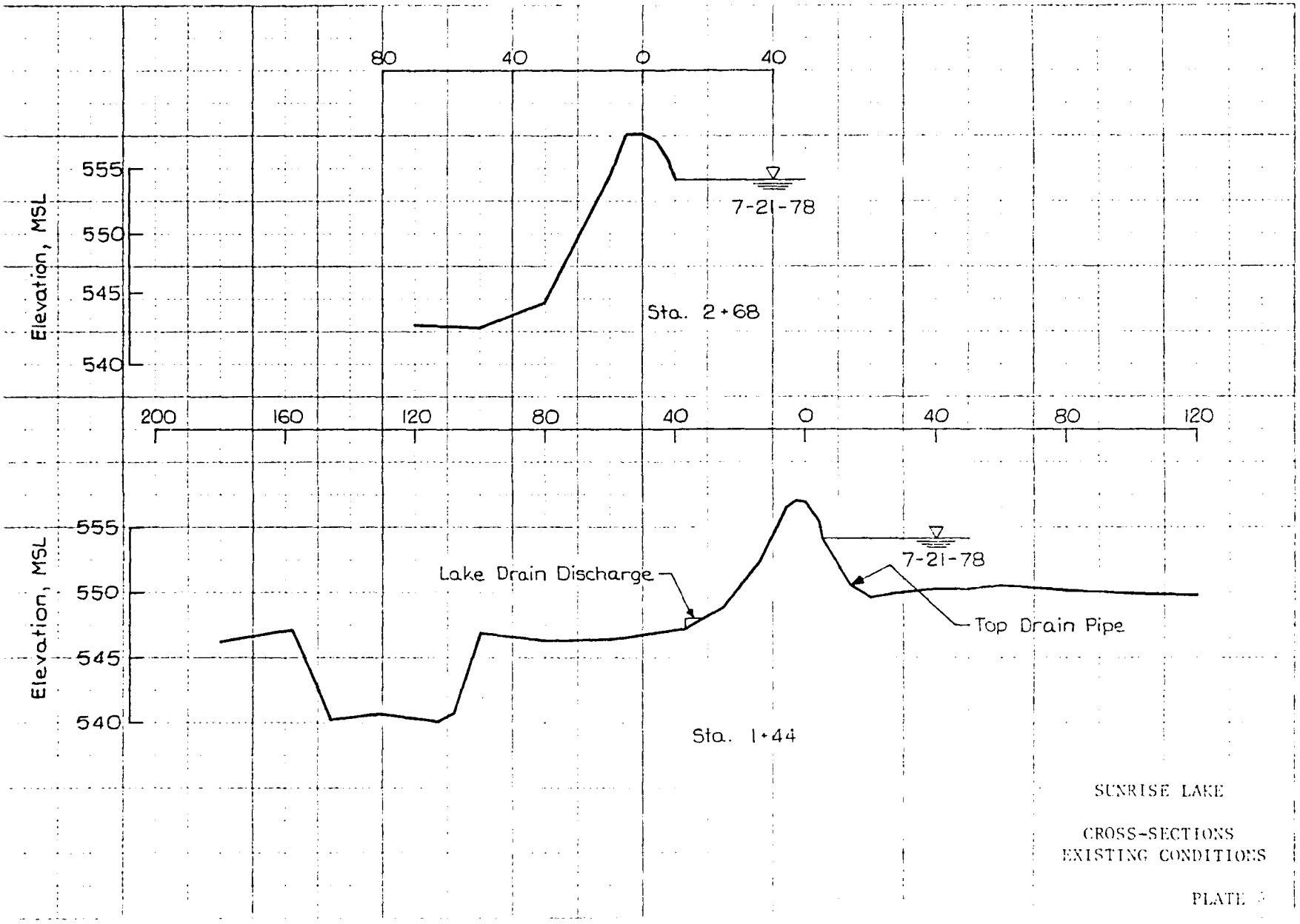
PLATE 2



SUNRISE LAKE

CENTERLINE PROFILE

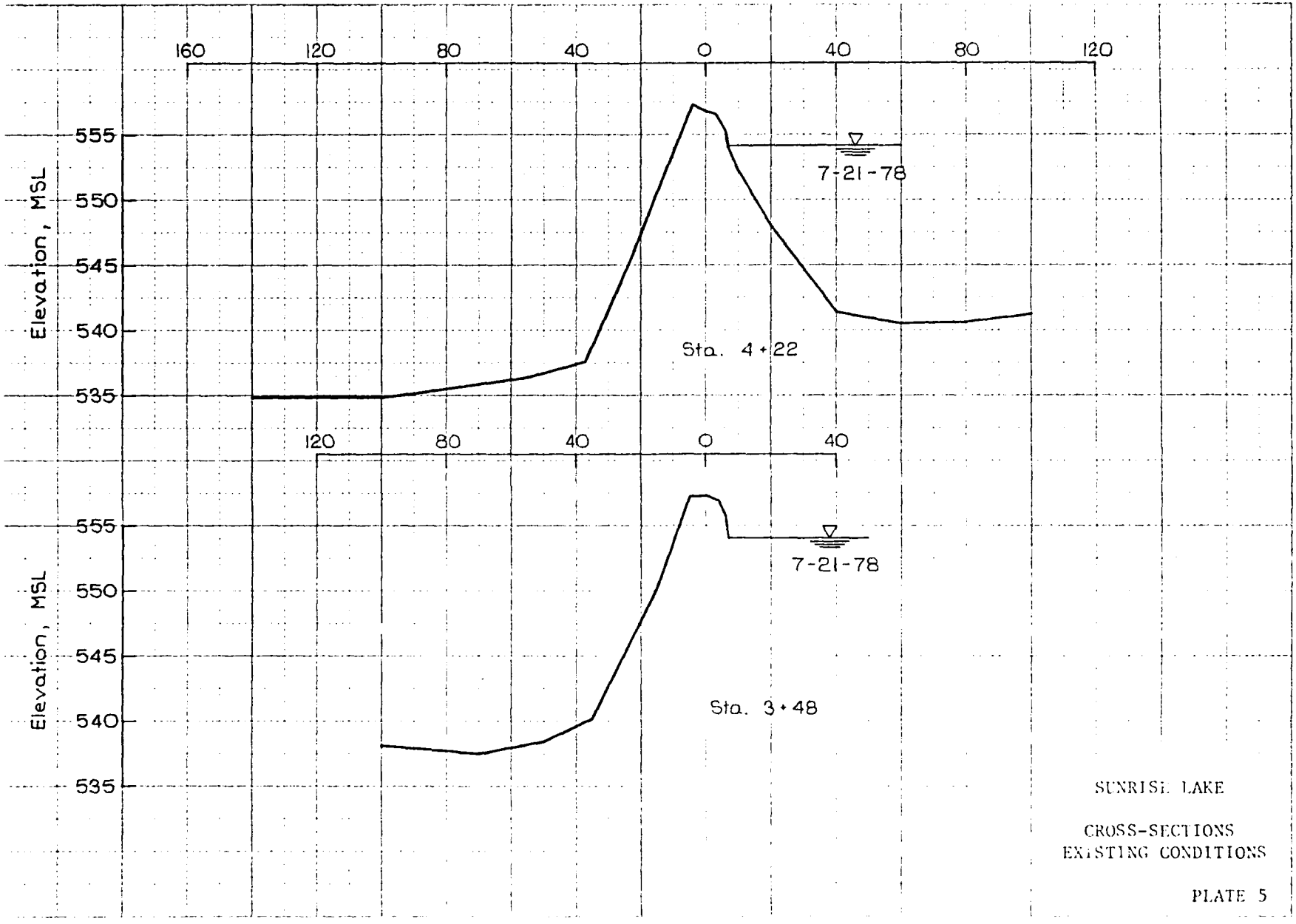
PLATE 3



SUNRISE LAKE

CROSS-SECTIONS
EXISTING CONDITIONS

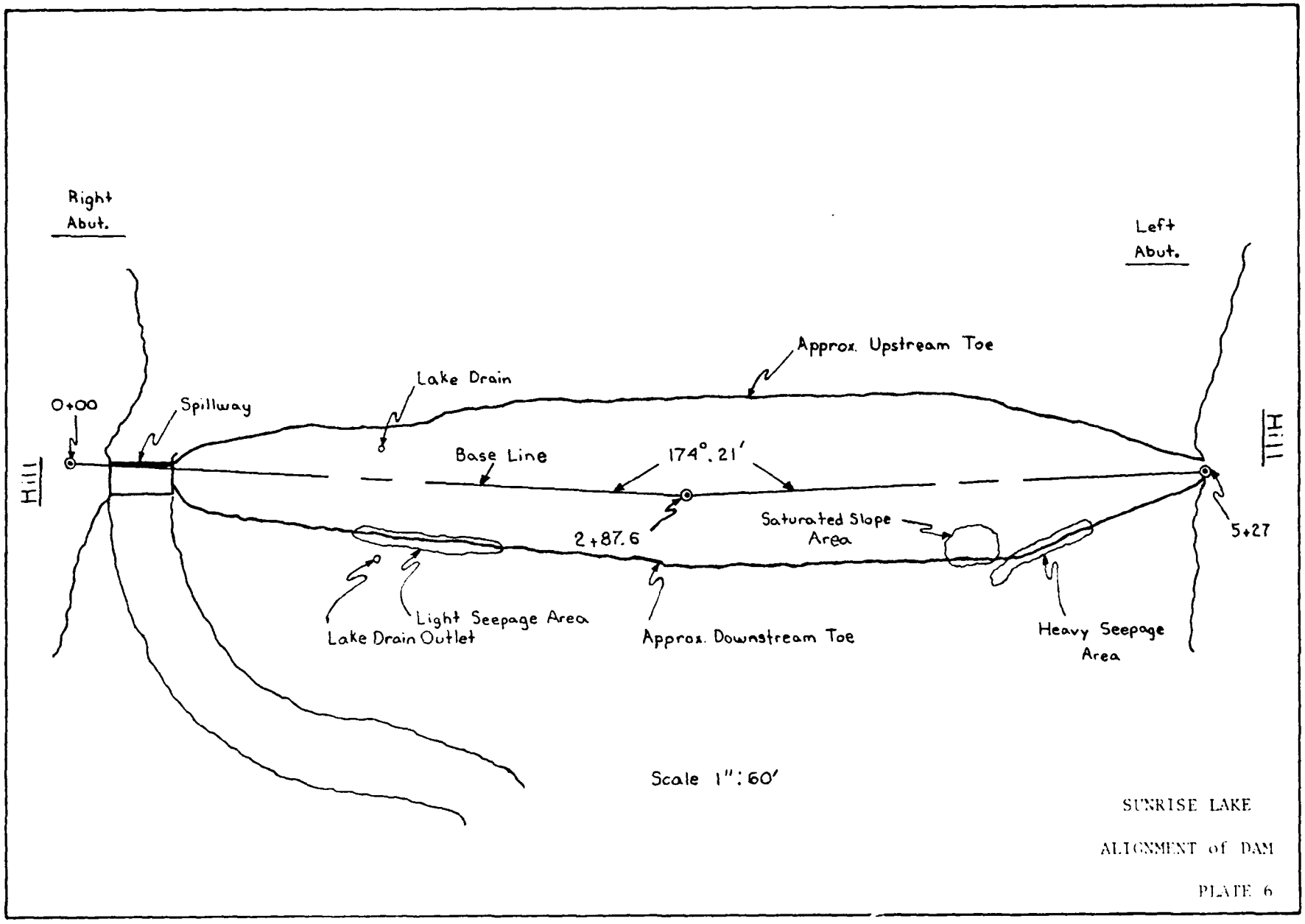
PLATE



SUNRISE LAKE

CROSS-SECTIONS
EXISTING CONDITIONS

PLATE 5



SUNRISE LAKE

ALIGNMENT of DAM

PLATE 6

PHOTO 1: Overview of Lake and Dam

PHOTO 2: Overview of Lake

PHOTO 3: Crest of Dam

PHOTO 4: Overview of Concrete Core Wall

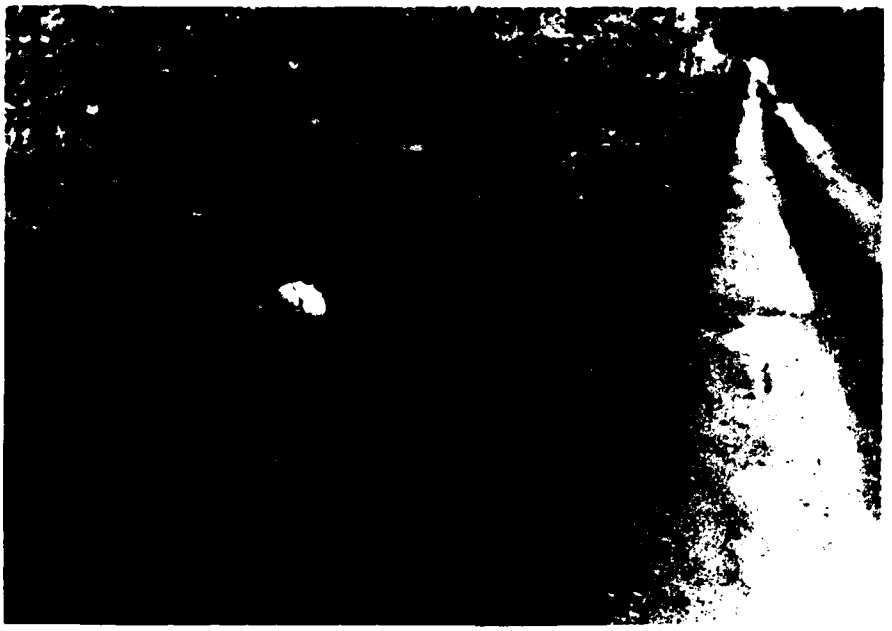


PHOTO 5: Concrete Core Wall in Vegetation

PHOTO 6: Concrete Core Wall - Protruding Reinforcing

PHOTO 7: Downstream Slope

PHOTO 8: Erosion Gully on Downstream Slope

PHOTO 9: Large Tree on Downstream Slope

PHOTO 10: Seepage Along Downstream Toe

PHOTO 11: Principal Spillway Weir

PHOTO 12: Principal Spillway - Bridge Crossing

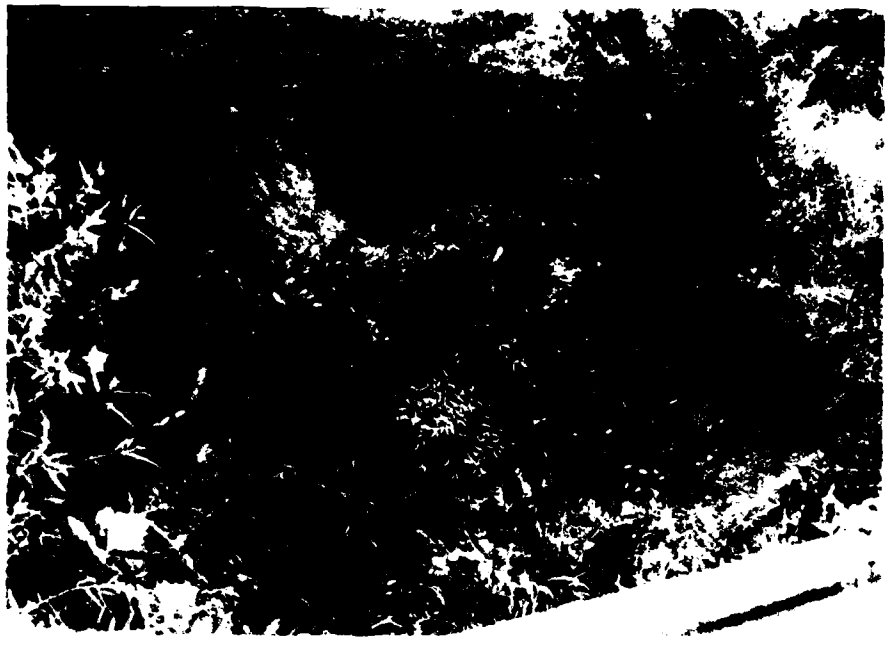


PHOTO 13: Paved Section of Principal Spillway Channel

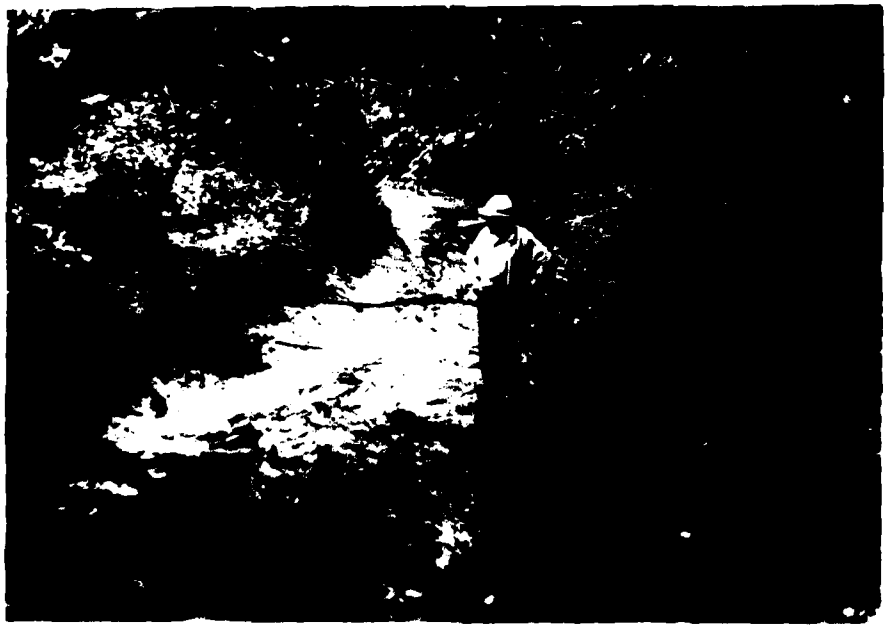
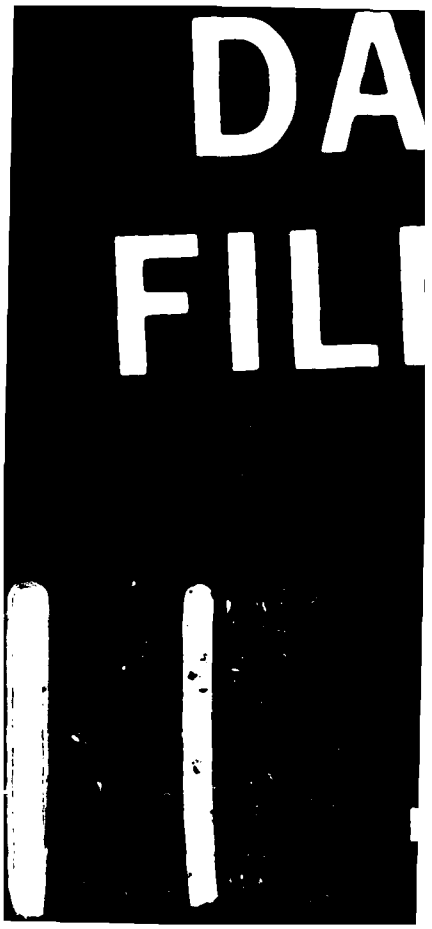


PHOTO 14: Principal Spillway Channel

PHOTO 15: Concrete Pad of Emergency Spillway (Foreground)

PHOTO 16: Lake Drain Discharge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